FINAL REPORT

ENERGY SAVINGS OPPORTUNITY SURVEY
FY 85 ENERGY ENGINEERING ANALYSIS PROGRAM
VARIOUS LOCATIONIS, EIGHTH US ARMY, KOREA

Prepared for

DEPARTMENT OF THE AMRY

FAR EAST DIVISION, CORPS OF ENGINEERS

SEOUL, KOREA

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EXECUTIVE SUMMARY

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1. Introduction

This study was prepared as part of the Engineering Energy Analysis Program (EEAP). The EEAP is a Department of Defense (DOD) program which was initiated in the late 1970's in response to a Presidential Order. The program's primary goal is to reduce energy consumption within the DOD thereby curbing dependence on foreign non-renewable energy sources, notably oil. The Energy Engineering Analysis Program (EEAP) is administrated by the U.S. Army Corps of Engineers through the Huntsville Division located in Huntsville, Alabama.

The EEAP program effort in Korea has consisted of two major studies. The first study occured in 1981 and consisted of basewide energy studies. The scope for these studies included looking at entire camps. The second effort under the EEAP program in Korea is this study. The scope of work for this study includes a total of 63 buildings located at 19 different camps throughout Korea from Taegu to the DMZ (see Figure 1). This study is properly known as an Energy Savings Opportunity Survey (ESOS). Since an ESOS is limited to examining individual buildings, energy savings projects are limited to the scale and complexity of the buildings within the study.

2. Study Methodology

The study was carried out in a three step procedure, beginning with detailed field building surveys. A multi-disciplinary field inspection team surveyed all of the 63 buildings (which include 61 buildings and 2 detached utility buildings). These surveys gathered all of the vital building characteristics which affect each buildings' energy consumption. All of the building thermal envelope properties were noted. Measurements were taken on total building electrical loads, boiler efficiencies, lighting intensity levels, space temperatures, domestic hot water temperatures, air flow quantities, and electrical motor loads. Other building data including building occupancy, and schedules were also noted. Assessments were made on individual building system status and condition. All possible Energy Conservation Opportunities (ECO) were identified at this time.

The second phase of the study included summarizing all of the field data collected and development of a data base. Included in this phase was determining the existing energy consumption of all of the 63 buildings by calculating heating, cooling, process, electrical power and lighting loads and developing an energy baseline for each building. All of the field data obtained during site surveys formed the basic input for the energy baseline data base.

The last phase of the study included analyzing each individual Energy Conservation Opportunity (ECO) to test its economic viability and determine both the implementation cost and the resulting energy and dollar savings. Those projects that provide energy savings and pay back within their economic life are recommended for funding. A number of repair projects were also identified and recommended for funding. Facilities Engineering Work Requests (FEWRs) were prepared for each building including all energy saving recommendations developed under this study.

3. Conclusions

A. Energy Savings

"Energy savings from recommended new construction, repair and operations and maintenance (O & M) energy conservation opportunity measures will result in overall annual energy savings of 55,Ø63 million Btu's of fuel oil and 1,541 megawatt-hours (MWH) of electric energy. This converts to a total savings of 6Ø,323 million Btu's per year when electric savings are converted using 3,413 Btu's per kilowatt-hour (KWH). Savings are broken down as follows:

Project	Fuel Oil 1Ø Btu/Yr	Electricity KWH/Yr	Total 1Ø Btu/Yr 1/
New Construction	35,847	1,337,128	4Ø,411
Repair Projects	1Ø,946	183,742	11,573
O & M Projects	8,271	2Ø,152	8,339
Subtotal Repair and O & M	19,216	2Ø3,894	19,912
Total 2/	55,Ø63	1,541,Ø22	6Ø,323

When developing the FY85 aseline it was assumed that certain repairs and O & M procedures had already been implemented. Thus, the difference between the FY85 and Future Baseline energy use shown on Figure 2 may not appear to agree with the above savings claims.

The resulting energy savings between FY 85 and Future Baselines is 27% for these 63 buildings which exceeds the overall Eighth U.S. Army (EUSA) FY 95 energy savings goal of a 1Ø% reduction. It is noted that most of the savings (4Ø%) occurs in the area of Heating, Ventilating and Air Conditioning (HVAC)."

B. Recommended Energy Saving Projects

Table 1 summarizes all of the energy saving opportunities recommended by this study. The projects are classified into three groups; new work, repair, and operations and maintenance. These groups include the FEWR funding allocations of OMA L, K, and M accounts respectively.

From a total investment of $1,150,243 for all projects, annual savings of $443,794 are realized. This allows for a payback period of 2.59 years. The total Life Cycle Cost (LCC) Savings for all the projects is $5,005,550.

C. Operations and Maintenance

Although a detailed study of AFE/DEH operations and maintenance procedures is not required by this energy study, certain generic problems specific to the Korean environment became evident during the detailed building surveys, which are worthy of note.

O & M crews do not understand new systems. As a result of the higher technology involved in the new facilities, the lack of sufficient personnel, and a long term O & M training program, actual maintenance crews lack the skills to enact proper maintenance. During site surveys automatic controls were found to be routinely defeated or bypassed. This condition was the rule and not the exception. Even an item as simple as a three-way automatic control valve was almost always found to be disconnected and manually controlled or bypassed.

The attendant O & M problems in Korea surface significant questions related to energy savings. Most energy saving opportunities require installation of many differing devices which although not "high tech" require a significant understanding of the purpose of the installation and a concurrent understanding of how the hardware components operate.

The approach taken in this study was to recommend energy conservation opportunities that can realistically be expected to be effective within the apparent limitations imposed by the unique aspects of O & M in Korea.

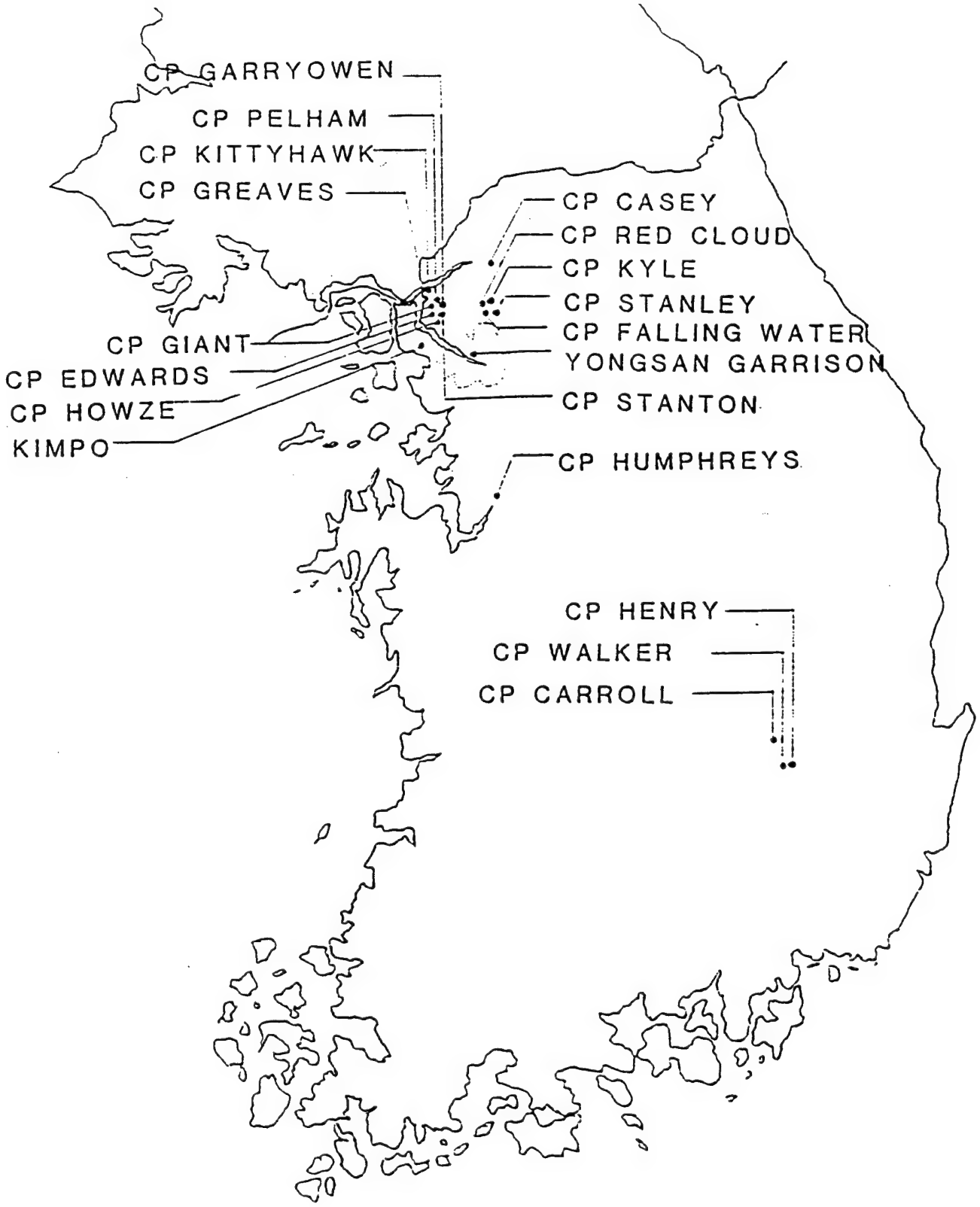
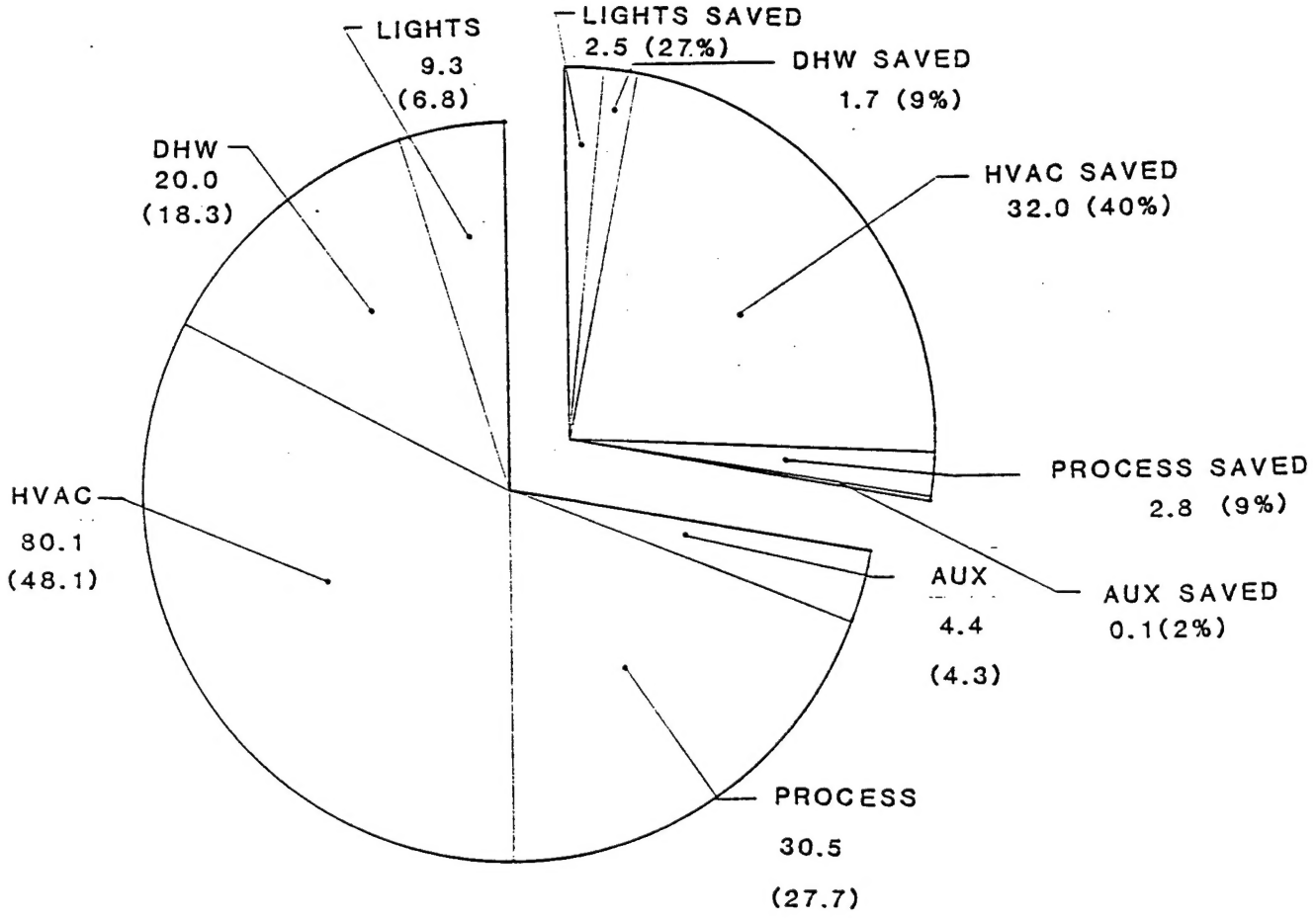


FIGURE 1

INSTALLATION LOCATION MAP

FY 85 EEAP,KOREA

FIGURE 2
FUTURE ENERGY USE
AND
SAVINGS FROM THE FY85 BASELINE



LEGEND

FY85 BASELINE ENERGY USE

ENERGY USAGE CATEGORY
BILLION BTU'S PER YEAR
(FUTURE BASELINE)

ENERGY SAVED-FY85 ESOS

ENERGY USAGE CATEGORY
BILLION BTU'S PER YEAR
(% FY85 BASELINE SAVED)

ELECTRICITY CONVERTED TO BTU'S USING 3,412 BTU PER KWH

TABLE 1

SUMMARY OF FY85 ESOS RECOMMENDATIONS

ECO NO.	DESCRIPTION	PROJECT TYPE	ENERGY SAVINGS (MIL BTU/Y)	SVD($/Y)	O&M COST SVD($/Y)	TOTAL SVD($/Y)	TOTAL LCC SAVED ($)	INVESTMENT NEW ($)	INVESTMENT REPAIR($)	SIR (RATIO)	PAYBACK (YEARS)
NEW CONSTRUCTION PROJECTS (FUNDING REQUESTED FROM OMA-L ACCOUNT)											
ML-11C	INSULATE COND. RECEIVERS & STEAM PRESSES	NEW CONSTRUCTION	446	$2,735	$0	$2,735	$30,607	$427	$0	71.66	0.16
MC-20A	SET-BACK THEMP CONTROLS	NEW CONSTRUCTION	14,849	$92,934	$0	$92,934	$1,033,970	$37,626	$0	27.48	0.40
E-32	DISCONNECT LIGHTING FIXTURES	NEW CONSTRUCTION	13	$223	$0	$223	$2,660	$188	$0	14.78	0.81
E-54	PROVIDE MORE LIGHT SWITCHING ZONES	NEW CONSTRUCTION	73	$1,253	$0	$1,253	$14,940	$1,404	$0	10.64	1.12
E-61	INSTALL PENDANT FIXTURES	NEW CONSTRUCTION	38	$657	$27	$684	$8,152	$1,063	$0	7.67	1.55
MC-12	FLUE DAMPERS ON BOILERS & WARM AIR FURNACES	NEW CONSTRUCTION	2,224	$13,632	($1,800)	$11,832	$136,141	$21,773	$0	6.25	1.84
MC-20C	ADD HVAC ZONES	NEW CONSTRUCTION	8,367	$52,437	($604)	$51,833	$577,688	$98,297	$0	5.88	1.90
E-37	REPLACE INCAND. FIXTURES WITH ENERGY SAVING FLUOR. LAMPS & BALLASTS FIXTURES	NEW CONSTRUCTION	1,235	$21,355	$30,546	$51,900	$610,487	$108,627	$0	5.62	2.09
E-30	TIMER SWITCHES FOR LIGHTING	NEW CONSTRUCTION	219	$3,782	$0	$3,782	$26,591	$4,856	$0	5.48	1.28
E-50	REPLACE EXIT SIGNS WITH MORE EFFICIENT FIXTURES	NEW CONSTRUCTION	335	$5,788	$3,532	$9,320	$85,248	$16,646	$0	5.12	1.79
MC- 1	IR SPACE HEATING RETROFIT	NEW CONSTRUCTION	1,143	$7,007	($14)	$6,993	$78,276	$15,422		5.08	2.21
ML-68	IMPROVE REACH-IN REFRIGERATOR PERFORMANCE	NEW CONSTRUCTION	51	$878	($16)	$862	$7,906	$1,762		4.49	2.04
E-49	REPLACE LIGHTING WITH HPS LIGHTS	NEW CONSTRUCTION	423	$7,322	$830	$8,152	$96,947	$24,323	$0	3.98	2.99
A-23	INSTALL INSULATION ON ROOFS OR IN CEILINGS	NEW CONSTRUCTION	3,841	$26,467	$0	$26,467	$379,466	$110,085	$0	3.45	4.16
E-38	SWITCH EXHAUST FANS WITH LIGHTS IN LATRINES & SHOWERS	NEW CONSTRUCTION	52	$895	$0	$895	$10,667	$3,609	$0	2.96	4.03
A-22	INSTALL INSULATION FOR EXTERIOR WALLS	NEW CONSTRUCTION	2,777	$20,779	$0	$20,779	$314,412	$106,638	$0	2.95	5.13
MC-64	INSULATE MECH ROOM WALLS	NEW CONSTRUCTION	153	$937	$0	$937	$15,345	$6,266	$0	2.45	6.69
E-47	REPLACE ENTRANCE LIGHTS WITH MORE EFF. FXTRS ON PHOTOCELL CNTRL	NEW CONSTRUCTION	187	$1,846	$397	$2,243	$26,625	$12,093	$0	2.20	5.39
ML-39	INSULATE RA DUCTWORK IN MECH. ROOMS	NEW CONSTRUCTION	20	$122	$0	$122	$1,366	$638	$0	2.14	5.22
MC-63	DISHWASHER DRN HT RECOVERY	NEW CONSTRUCTION	898	$5,503	($728)	$4,775	$54,945	$26,622	$0	2.06	5.58
E-62	INSTALL HALLWAY TIMER SWITCHES	NEW CONSTRUCTION	197	$3,412	$0	$3,412	$31,287	$17,028	$0	1.84	4.99
ML-23	HEATING HOT WATER TEMPERATURE RESET CONTROLS	NEW CONSTRUCTION	62	$382	($48)	$334	$3,833	$2,286	$0	1.68	6.85
ML-33	INSULATE REFRIGERANT PPG	NEW CONSTRUCTION	0	$7	$0	$7	$67	$41	$0	1.65	5.57
MC-62	HEAT RECOVERY FOR DWH FROM COOLING REFIGERATION	NEW CONSTRUCTION	397	$2,435	($18)	$2,417	$27,082	$16,575	$0	1.63	6.86
A-15-N	REPLACE WINDOWS WITH THERMAL WINDOWS	NEW CONSTRUCTION	186	$1,166	$0	$1,166	$15,529	$9,854	$0	1.58	8.45
E-42	TIME CLOCKS FOR WATER COOLERS & VENDING MACHINES	NEW CONSTRUCTION	49	$848	$0	$848	$5,958	$3,845	$0	1.55	4.54

ECO NO.	DESCRIPTION	PROJECT TYPE	ENERGY SAVINGS (MIL BTU/Y)	SVD($/Y)	O&M COST SVD($/Y)	TOTAL SVD($/Y)	TOTAL LCC SAVED ($)	INVESTMENT NEW ($)	INVESTMENT REPAIR($)	SIR (RATIO)	PAYBACK (YEARS)
MC-61B	VAV RETROFIT IN S-292 CAMP RED CLOUD	NEW CONSTRUCTION	387	$2,833	($156)	$2,677	$27,387	$19,892		1.43	7.13
MC-18	CMMRCL DRYER HEAT RECOVERY	NEW CONSTRUCTION	722	$4,359	($312)	$4,047	$46,147	$32,459	$0	1.42	8.02
E-66	INSTALL ENERGY EFFICIENT MOTORS	NEW CONSTRUCTION	46	$799	$0	$799	$9,523	$6,732	$0	1.41	8.43
E-36	REPLACE STANDARD FLUOR. WITH ENERGY SAVING FLUOR. LAMPS & BALLASTS	NEW CONSTRUCTION	221	$3,813	($619)	$3,194	$38,234	$26,264	$0	1.35	8.85
MC-60A-N	CLNG SYS ECONOMIZER RETROFITS	NEW CONSTRUCTION	37	$636	($32)	$604	$5,539	$4,425	$0	1.25	7.33
ML-57	REPLACE ELEC DHW HTR WITH FO FIRED HTR	NEW CONSTRUCTION	(8)	$463	$0	$463	$4,044	$3,370		1.20	7.28
MC-38	LNDRY DRAIN HEAT RECOVERY	NEW CONSTRUCTION	1,811	$18,952	($278)	$18,674	$177,177	$163,988	$0	1.08	15.36
E-46	RELOCATE LIGHTING FXTRS	DO WITH E-36&37	NA	NA	NA	NA	NA	NA	NA	NA	NA
SUBTOTAL NEW CONSTRUCTION PROJECTS			40,411	$298,658	$30,706	$329,364	$3,904,087	$986,235	$0	4.31	2.75
OPERATION AND MAINTENANCE PROJECTS (FUNDING REQUESTED FROM OMA-M ACCOUNT) (3)											
ML- 2	(1)REMOVE UNAUTHORIZED ICE MACHINE	O & M	8	$130	$0	$130	$1,191		($1,852)	NA	NA
ML- 3	(2)RESET DHW TEMPERATURES	O & M	4,261	$26,788	($986)	$25,802	$0	$0	$0	NA	0.04
ML- 6	(1)REMOVE UNAUTHORIZED DHW FROM SLOP SINKS	O & M	41	$263	$0	$263	NA	$0	$72	NA	0.27
ML-29	(2)RETUNE BOILER COMBUSTION CONTROLS	O & M	3,980	$24,400	($10,206)	$14,194	NA	NA	NA	NA	0.42
ML-45	(2)CVR WINDOW ACCU's IN WNTR	O & M	50	$308	($173)	$135	NA	$0	$0	NA	0.56
SUBTOTAL OPERATION AND MAINTENANCE PROJECTS			8,339	$51,889	($11,365)	$40,524	$1,191	$0	$72	NA	0.22
REPAIR PROJECTS (FUNDING REQUESTED FROM OMA-K ACCOUNT)											
ML-27	(1)REMOVE HEAT FROM VESTBLS, STRWLLS & STRG AREAS	REPAIR	1,035	$6,345	$0	$6,345	$103,924	$0	$398	261.37	0.06
ML-14	REPLACE STEAM TRAPS	REPAIR	5,640	$34,573	$0	$34,573	$566,309	$0	$9,566	59.20	0.28
ML-11B	INSULATE HHW PIPING	REPAIR	335	$2,056	$0	$2,056	$23,009	$0	$416	55.26	0.20
ML-11A	INSULATE DHW PIPING	REPAIR	106	$648	$0	$648	$7,246	$0	$217	33.42	0.33
ML-36	INSTALL ASPIRATORS ON LAVORATORY FAUCETS	REPAIR	101	$637	$0	$637	$7,075	$0	$604	11.72	0.95
ML- 7	REPLACE LEAKING PRV's	REPAIR	51	$313	$0	$313	$5,131	$0	$604	8.49	1.93
MC-20B	HVAC SYSTEM REPAIRS	REPAIR	558	$3,446	$0	$3,446	$38,479	$0	$9,351	4.11	2.71
A- 4	REPLACE FAILING DAMPERS	REPAIR	43	$365	$0	$365	$5,291	$0	$1,455	3.64	3.99
MC-61A	DEDICATED COOLING SYSTEM IN S-292 CAMP RED CLOUD	REPAIR	194	$3,351	$0	$3,351	$30,728		$9,609	3.20	2.87
ML-46	INSTALL FIREPLACE DAMPERS	REPAIR	8	$49	$0	$49	$549	$0	$178	3.08	3.63

ECO NO.	DESCRIPTION	PROJECT TYPE	ENERGY SAVINGS (MIL BTU/Y)	SVD($/Y)	O&M COST SVD($/Y)	TOTAL SVD($/Y)	TOTAL LCC SAVED ($)	INVESTMENT NEW ($)	INVESTMENT REPAIR($)	SIR (RATIO)	PAYBACK (YEARS)
MC-55	REPLACE BLRS & WAF's	REPAIR	454	$2,783	$2,080	$4,863	$69,818	$0	$26,215	2.66	5.39
A- 1	REALIGN AND WEATHERSTRIP PERSONNEL DOORS	REPAIR	413	$2,531	$0	$2,531	$41,461	$0	$20,462	2.03	8.08
A-15-R	REPLACE WINDOWS WITH THERMAL WINDOWS	REPAIR	418	$3,795	$0	$3,795	$53,329	$0	$38,579	1.38	10.17
ML-15	REPLACE EVAPRTR DEFROSTERS	REPAIR	94	$1,619	$0	$1,619	$14,846		$10,764	1.38	6.65
A- 2	REPLACE FAILING PERSONNEL DOORS	REPAIR	668	$5,715	$0	$5,715	$82,485	$0	$67,117	1.23	11.74
MC-17	ADD WATER TREATMENT TO PREVENT TUBE SCALING	REPAIR	1,396	$8,557	($6,120)	$2,437	$40,002	$0	$37,664	1.06	15.45
MC-60A-R	CLNG SYS ECONOMIZER REPAIRS	REPAIR	67	$1,164	$0	$1,164	$10,669	$0	$10,737	0.99	9.23
SUBTOTAL REPAIR PROJECTS			11,573	$77,946	($4,040)	$73,906	$1,100,272	$0	$243,936	4.51	3.30
GRAND TOTAL FOR ALL PROJECTS RECOMMENDED FOR FUNDING			60,323	$428,493	$15,301	$443,794	$5,005,550	$906,235	$244,008	4.35	2.59

GENERAL: REPAIRS ALREADY COMPLETED AS A RESULT OF THE INTERIM SUBMITTAL ARE NOT INCLUDED IN THE ABOVE TOTALS.
ELECTRIC ENERGY SAVING ARE CONVERTED TO BTU's USING 3413 BTU's PER KWH.

(1) THIS PROJECT REMOVES AN EXISTING SERVICE. THERE IS NO EQUIPMENT EXPENSE TO AMORTIZE OVER A LIFE CYCLE, THUS NO LIFE CYCLE COST ANALYSIS IS PROVIDED.

(2) THIS PROJECT REQUIRES THE ADDITION OF OPERATION AND MAINTENANCE AS A RECURRING COST WITHOUT A ONE-TIME INVESTMENT IN EQUIPMENT THAT MUST BE AMORTIZED. THUS, A LIFE CYCLE COST ANALYSIS IS NOT PROVIDED.

(3) FUNDS ARE REQUESTED ON FACILITIES ENGINEERING WORK REQUESTS FOR THE FIRST YEAR's ADDITIONAL OPERATION AND MAINTENANCE COSTS AND FOR ANY REQUIRED INVESTMENT FOR THESE PROJECTS.